Teaching Mathematics in the 21st Century

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TEACHING MATHEMATICS FOR THE 21ST CENTURY

My teaching will greatly be enhanced by the knowledge I've acquired while taking this math course. The course has helped me to re-affirm my convictions of healthy math instruction and then build new networks of ideas (based on research) into my methodology. Realizing this will be a developmental process for me, I have chosen 6 areas to improve my effectiveness: cooperative grouping, high level questioning, problem solving, displaying work, calculators and computers, and male/female differences.

I have significantly increased the amount of cooperative learning activities used in my classroom. County workshops have provided me some excellent experiences to incorporate this valuable method for math exploration and problem solving. Marilyn Burns publications have opened new avenues for leading small groups. Fourth graders really like working in small groups and at this age I feel it satisfies the great need they have for attention because it is supportively independent. Ten year olds don't want too much teacher involvement with their work, yet they still need personal feedback and support. When they are supported by their peers, they feel valued and significant. Cooperative grouping has been demonstrated to involve all children in the learning activity and to cause achievement gains, particularly among slower or less interested children. (Johnson & Johnson 1975) According to this research, 4 or 5 children is a good group size.

Through cooperative grouping I can develop themes which would integrate math, social studies, science and language arts. This year I accomplished this with my consumer economics project "Oxygen for All". We based our business on the need for oxygen on our planet. All areas integrated beautifully for this endeavor. Cooperative groupings enabled the children to participate in every function of our business: advertising, production and sales. In the future I plan to add more thematic units, keying in on cooperative groups as a tributary method.

When using the cooperative learning process, it is important to collectively come together as a class and reach some conclusions. During these debriefing times high level questioning strategies can generate transfers of knowledge and analogies. Research shows that teachers need to give students time to think after asking a question. When wait-time is given, results are that responses are longer, more complete and frequently reflect greater understanding.(Budd Rowe 1978 a,b, 1979) I need to self evaluate my questioning skills and specifically plan activities which would stimulate higher level thought. Ideally this sounds basic enough, however this skill is tough in real life situations. In real life there are time restraints and each year something additional is added to our required curriculum. In real life sometimes awareness of negative student conduct can effect the cognitive progression a teacher is trying to establish. In real life there are times when students are too tired to be sharp thinkers. My afternoon class is a case in point. They tend to be tired and lethargic

after lunch and P.E. Instead of stimulating an eagerness to know more, sometimes I feel like I'm performing a tooth extraction trying to get something out of them. Creating an atmosphere of discovery, promoting children's input without fear of rejection and choosing topics which spark their interest are needed to set the stage for questioning strategies. Even my afternoon class will respond if I prepare them and build on what they already know.

High level questioning techniques are necessary for building problem solving constructs in children. According to our text, problem-solving experiences can contribute to knowledge development as much as knowledge development contributes to problem-solving ability. In fact, the most important reason for integrating problem solving into instruction may be the contribution such experiences make to students' understandings of basic mathematical ideas, as well as to increasing general problem-solving ability.(Lesh, Zawojewski,1988) Problem-solving should therefore be a daily diet in my classroom. Through journaling or daily warm ups students will become familiar with a variety of problems to solve . George Polya's ideas are very appealing because they are simple, general steps which can be applied to a broad range of problem-solving types. Heuristics that are too specific won't generate the creative solutions needed for problems in the 21st century. Polya advocates that students use self generated questions to help themselves when they are "stuck" during solution attempts. These strategies or heuristics were intended to help students think about their own

thinking strategies so they could discover useful solution paths. (Polya, 1957,1962,1965) The heuristics help me to generate thinking although it is a developmental process for me as a teacher. My confidence is growing as I study techniques and work with students. Using the five representational systems (manipulative models, static pictures, written symbols, spoken language, and real scripts) and having students translate from one mode to another opens up a new arena for me as a teacher. Not only will this help with story problems and everyday math situations, but also with diagnosing difficulties.

In order to show students the value of problem-solving I need to display their work more often in the classroom and around the school. As a general rule, children who have expressed themselves to the best of their ability on paper or through some other medium should have their work displayed(Johnson 1983) Next year I plan to start "Word Problem of the Week" and display in the hall one student's written explanation of their problem solving.

Providing activities that involve calculators and computers will continue to be integral tools in my classroom. Calculators and computers play a major role in numeric and symbolic calculations of adults in our society. There have been over 150 studies on the effects of calculators on school mathematics learning(Suydam,1981b,1983) The evidence is overwhelmingly in favor of the use of calculators. Research provides little evidence of the feared debilitation, and children enjoy using them.(Shumway 1981) Computer uses that show the most promise in

the elementary classroom are drill and practice for skill learning,and student programming with exploration of simulations for concept learning and problem solving. (Suydam 1984)

In motivating students to perform there are differences in how girls and boys respond to math activities. These differences have been intriguing to me and studying the text for this course has confirmed my observations. All teachers should be aware of sexual preference in their classrooms. It is important that all children have an equal opportunity to learn.

Girls and boys enter elementary school at about the same mathematics knowledge level.(Callahan/Clements 1984) Starting in late elementary school and increasing throughout high school, differences between girls and boys on mathematical tasks are apparent.(NAEP,1983) Girls learn what is taught somewhat better than boys, while boys are better able to transfer their learning to untaught high cognitive level situations.(Fennema, 1984) Males tend to attribute success to internal causes and failures to external or unstable causes. Females tend to attribute success to external or unstable causes and failures to internal causes. This behavior strongly affects achievement.(Bar-Tal 1978)

Social influences aren't helpful. Unfortunately parents are more apt to discuss math with their sons than with their daughters, are more supportive of their son's math interest and hold lower educational aspiration for their daughters (Fox 1980) There is a great deal of evidence that teachers interact more with boys than they do with girls(Brophy 1985) In many cases teachers interact more with boys because they feel they must to

maintain control because boys often demand more behavioral attention. Boys appear to learn better in a competitive environment while girls learn better in cooperative situations.(Peterson & Fennema 1985)

Somehow I need to meet these individual differences more effectively. I intend to monitor my time equally among girls and work harder to encourage them by constant reinforcement when they transfer knowledge into other situations. Retraining parents that math is not a male/female inherited trait will take carefully thought out communication skills.

Overall my math program is substantive, however I want to utilize all sound components of a math curriculum that will carry students successfully into the 21st century. This course has afforded me the opportunity to take a closer look at what goes on in my classroom. Dr. Helton has given practical direction in bringing "real world" math directly to students. Research findings have given me a foundation of support for my methodolgy. The knowledge I've gained from this course is NOT more of a burden for me to have to disseminate, but rather an extension of new avenues to investigate.

References

Bar-Tal, D. 1978. Attributional analysis of achievement-related behavior. Review of Educational Research, 48::259-271

Brophy, J.E. 1985 Interactions of male and female students with male and female teachers.In L.C. Wilkinson & C.B. Marrett (Eds.), Gender-related Differences in the Classroom. New York::Academic Press.

Budd-Rowe, M. 1978a. What research says to the science teacher: Vol 1. Washington, DC: National Science Teachers.
Budd-Rowe, M. 1978b Teaching science as continuous inquiry:A basic 2-E. New York:Mcgraw-Hill.
Budd-Rowe, M. 1979. What research says to the science teacher: Vol. 2 Washington, DC: National Science Teachers.

Callahan, L.G. & Clements, D.H. 1984. Sex differences in rote-counting ability on entry to first grade: Some observations. Journal for Research in Mathematics Education, 15(5)::378-382

Fennema, E. 1984. Girls, Women, and mathematics. In E. Fennema && M.J. Ayer(Eds.), Women and education: Equity or equality? Berkeley: McCutchan Publishing Corporation.

Fox,L.H. 1980. The problem of women and mathematics. A report to te Ford Foundation, New York: Ford Foundation.

Johnson,M.L. 1983 Fall. Writing in mathematics classes: A valuable tool for learning. Mathematics Teacher, 76:117-119.

Johnson,D.W., & Johnson, R.T. 1975. Learning together and alone:Cooperation, competition, and individualization. Englewood Cliffs, NJ:Prentice Hall.

National Assessment of Educational Progress 1983. The Third National Mathematics Assessment:Results, trends, and issues(Report NO. 13-MA--01). Denver: Education Commission of the United States.

Peterson,P.L. & Fennema, E. 1985. Effective teaching, student engagement in classroom activities, and sex-related differences in learning mathematics. American Educational Research Journal, 22(3):309-335.

Polya, G. 1965.. Mathematical discovery:: On understanding, learning and teaching problem solving. Vol2. New York:Wiley.

Shumway, R.J., White, A..L., Wheatley, G.H., Reys, R.E., Coburn, T.G>, & Schoen, H.L. 1981. Initial effects of calculators in elementary school mathematics.. Journal for Research in Mathematics Education. 12:119-141.

Suydam, M.N. 1984.. Microcomputers in mathematics instruction. The Arithmetic Teacher, 32(2):35.